[0022] With the embodiments provided in the present invention, the time on the mobile device can be adjusted in a simply manner and thus the accuracy of the time is improved at a low cost.

BRIEF DESCRIPTION OF THE DRAWINGS

[0023] The above and other features of the present invention will become more apparent through detailed explanation on the embodiments as illustrated in the embodiments with reference to the accompanying drawings. Like reference numbers represent same or similar components throughout the accompanying drawings of the present invention, wherein:

[0024] FIG. **1** schematically illustrates a diagram of the various time segments in GSM system;

[0025] FIG. **2** schematically illustrates a flow chart of the method for adjusting time on a mobile device according to an embodiment of the present invention;

[0026] FIG. **3** schematically illustrates a flow chart of steps of determining a time adjustment amount according to an embodiment of the present invention;

[0027] FIG. **4** schematically illustrates a block diagram of an apparatus for adjusting time according to an embodiment of the present invention; and

[0028] FIG. **5** schematically illustrates a block diagram of an apparatus for adjusting time according to another embodiment of the present invention.

DETAILED DESCRIPTION OF EMBODIMENTS

[0029] Hereinafter, a method and apparatuses for adjusting time, a computer-readable storage media and a computer program product as provided in the present invention will be described in detail through embodiments with reference to the accompanying drawings. It should be understood that these embodiments are presented only to enable those skilled in the art to better understand and implement the present invention, not intend for limiting the scope of the present invention in any manner.

[0030] It should be first noted that this invention is illustrated in particular sequences for performing the steps of the methods. However, these methods are not necessarily performed strictly according to the illustrated sequences, and they can be performed in reverse sequence or simultaneously based on natures of respective method steps. Beside, the indefinite article "a/an" as used herein does not exclude a plurality of such steps, units, devices, and objects, and etc.

[0031] It is known that the GSM standard was designed to be a secure mobile phone system with strong subscriber authentication and over-the-air transmission encryption. In the GSM encryption algorithm, the frame number is one of variables. FIG. **1** schematically illustrates the various time segments in GSM system. As illustrated in FIG. **1**, a TDMA frame comprises eight time slots TS**0** to TS**7**, during each of which a normal burst is transmitted. Each time slot lasts 576.9 μs, and thus the duration of TDMA frame is 4.615 ms (576.9 μs×8). A Multiframe is composed of multiple TDMA frames and a Superframe is composed of multiple Multiframes. However, the Superframe consists of 1326 TDMA frames and lasts 6.12 s whether it is a CCH or TCH frame. A Hyperframe is composed of 2048 superframes, or in other word, it consists of 2715648 TDMA frames. Therefore, the hyperframe lasts 12533.76 seconds, i.e., 3 hours, 28 minutes, 53 second sand 760 milliseconds (about 3 and a half hours). Each TDMA frame is numbered according to its sequence within the hyperframe, starting from 0 and ending at 2715647.

[0032] The present inventor realizes from the above information that each TDMA frame lasts a certain time and the change of frame number means the lapse of time. Generally, the time on the base station is quite stable. The frame number is generated at base station based on the clock provided thereon and thus the frame number is quite stable and will not drift as the time on the mobile device, i.e. the local time, does.

[0033] Moreover, as mentioned above, in the GSM encryption algorithm, the frame number is one of input parameters; the base station will inform the mobile device of the frame number to decrypt the encrypted information. That is to say, the information about frame number is available for the mobile device. Therefore it is possible for the mobile device to use the frame number from a GSM network base station to count time and further for time adjustment.

[0034] Additionally, as mentioned above, the frame number will loop roughly every 3.5 hours. However, it will not cause any problem because the present invention is mainly intended to make a small change (in order of minutes, at most up to 3.5 hours) to the time on the mobile device.

[0035] The idea of the present invention is to use the frame number from a GSM network base station to count time, compare it with the time that the RTC on a mobile device is counting and adjust the latter if it seems to be drifting. Hereinbelow, detailed description of the present invention will be given based on the GSM system.

[0036] Reference is made to FIG. **2**, which schematically illustrates a flow chart of a method for adjusting time according to an embodiment of the present invention.

[0037] As illustrated, at step S**201**, a time adjustment amount is determined based on at least a history frame number for a cell, a history timestamp corresponding to the history frame number, a current frame number for the cell, and a current timestamp corresponding to the current frame number.

[0038] FIG. **3** schematically illustrates an embodiment of a flow chart of steps of determining a time adjustment amount according to an embodiment of the present invention.

[0039] First, at step S**301**, a time difference is determined based on the history timestamp and the current timestamp. During that step, time difference between two time points is determined in accordance with the time on the mobile device. Hence, it can obtain the time period after the history timestamp.

[0040] Then, at step S**302**, a theory frame number is determined based on the time difference and the history frame number. Based on the time difference determined in S**301**, it can determine how many frame numbers there are during the time period after the history timestamp. After that based on the number of frame numbers and the history frame number, the theory current frame number can be determined. Herein, the theory current frame number refers to the frame number which is expected in accordance with the time on the mobile device.

[0041] Next, at step S**303**, the time adjustment amount is calculated based on the theory frame number and the current frame number. The current frame number is obtained from the base station, and as mentioned above, the time on the base station is quite stable and thus the current frame number can represent a real time. The theory frame number is determined based on the time on the mobile device, it represent information about the time on the mobile device. Therefore, the